# New AI tools power smarter epidemic models and safer futures

## ASU research innovations can help public health officials make faster, more informed decisions during disease outbreaks

By Kelly deVos, ASU News
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Every Monday morning, thousands of parents ask themselves a difficult question: Is my child too sick to go to school?

When searching for an answer, studies indicate that parents weigh many factors, including their child's symptoms, the likelihood of making others sick, the school's attendance policies and looming tests or assignments. The clock is ticking, and choices must be urgently made.

Now imagine that — but for a whole population.

When illness spreads through a population in patterns that suggest large-scale transmission and escalation, that is called an epidemic.

Public health officials shift into high gear. They must make the same kinds of decisions as America's parents, but on a massive scale, weighing plans designed to help large groups of people avoid contracting a disease while minimizing disruptions to society. To get it right, these officials need reliable information.

That's where data scientists like K. Selçuk Candan come in.

Candan is a professor of computer science and engineering in the School of Computing and Augmented Intelligence, part of the Ira A. Fulton Schools of Engineering at Arizona State University. He is leading a new research initiative that could dramatically change how experts respond to emerging disease threats.

Backed by a grant from the National Science Foundation Accelerating Computing for Epidemic Discovery program, Candan and his team are building a system called PanAX, a powerful new approach to epidemic modeling and decision support.

PanAX is a new data modeling tool that uses data science and artificial intelligence, or AI, to learn from past epidemics and apply that knowledge to new or potential ones. Instead of starting from scratch each time a new epidemic emerges, PanAX combines past data and existing models and then uses machine learning to quickly assess how a disease might spread under various conditions.

“An epidemic is shaped by how people behave, where they live, how mobile they are and what decisions are made,” Candan says. “PanAX helps account for all of that, even when we have limited data.”

## A smarter way to model epidemics

In traditional epidemic modeling, scientists use mechanistic models, or sets of equations, to estimate how diseases might spread. These models depend on various factors, like infection and recovery rates, which often must be inferred from data that is limited as an epidemic is emerging. That makes the models difficult to apply when time is short and the stakes are high.

The PanAX team includes Professor Gerardo Chowell, a public health expert from Georga State University; ASU Regents Professor Huan Liu; and Maria Luisa Sapino, a professor at the University of Turin in Italy and a Fulton Schools adjunct faculty member.

They address key challenges by applying causal reasoning and machine learning to the problem. Rather than building a model anew for each outbreak, PanAX is designed to identify shared patterns across outbreaks that have occurred at different times and in different locations.

For example, if a flu outbreak emerges in Arizona, PanAX might analyze similarities with previous outbreaks in California or with last year’s flu season. By identifying which variables are consistent, such as disease characteristics, and which differ, like population behavior or climate, the system can fill in gaps and make more informed predictions.

“One of the key innovations,” Candan says, “is figuring out what knowledge can be transferred from one situation to another. Not everything applies, and transferring the wrong data can lead to bad decisions.”

This ability to reuse models from similar but distinct scenarios is central to the system’s design.

The team also uses causally informed techniques to separate disease-specific factors from context-specific ones. That means the system can better understand not just what is happening, but why — a critical distinction for both prediction and planning.

### Why this research matters

## From research lab to real-world impact

Importantly, PanAX also includes a strong education component. Students involved in the research are being trained in advanced methods in data science and AI, with applications to epidemiology and public health.

The project is part of a larger research ecosystem that Candan has helped grow at ASU. It builds on earlier work from the NSF-funded PanCommunity project, which explored how different communities respond to epidemics and how those differences impact disease spread and recovery.

That focus on data-driven insights and interdisciplinary collaboration also carries into Candan's role as associate director for technology at the recently established NSF Center for the Analysis and Prediction of Pandemic Expansion, or APPEX. One of four national centers of its kind, APPEX promotes a multidisciplinary approach to forecasting and mitigating disease outbreaks. This fall, the West Valley campus will become the center's new home.

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But Candan's impact in data science extends well beyond epidemic modeling. He has published more than 200 peer-reviewed articles, holds 10 patents and has secured more than $34 million in research funding. He is also the founding director of the ASU Center for Assured and Scalable Data Engineering, or CASCADE, where he and his team develop technologies with applications in health care, sustainability, security and beyond.

"The amazing thing about data science is that you can work on problems that matter, whether that's helping children with brain trauma, reducing energy waste in buildings, improving water resilience of the nation or helping communities respond to epidemics," Candan says.

## Modeling what matters

As disease threats continue to evolve, so too must our tools for understanding and responding to them. With PanAX, Candan and his collaborators are laying the groundwork for smarter, faster and more effective epidemic response.

Ross Maciejewski, director of the School of Computing and Augmented Intelligence, says that by combining rigorous science with real-world impact, PanAX exemplifies the school's research and educational missions.

"Selçuk is no stranger to transformative ideas," Maciejewski says. "Over the course of his distinguished career at ASU, he's earned a reputation as both an accomplished researcher and a deeply committed educator out to drive discovery and train the next generation of leaders."

PanAX aims to help officials, scientists and medical professionals make faster, more accurate predictions during public health emergencies, without waiting weeks or months for the right data to accumulate.

“We can’t prevent every outbreak,” Candan says. “But we can make sure we’re better prepared. That starts with the right data, the right models and the right mindset.”

*This story originally appeared on [ASU News](#).*

## Main image


K. Selçuk Candan, a professor of computer science and engineering in the School of Computing and Augmented Intelligence, part of the Ira A. Fulton Schools of Engineering at Arizona State University, poses for a photo in a lab. He leads a research team developing new tools powered by data science and artificial intelligence to supply faster, more accurate data to officials and the public during disease outbreaks. Photo by Erika Gronek/ASU